United States Patent [19]

Cobb, Jr.

[11] **Patent Number: 4,906,070**

[45] **Date of Patent: Mar. 6, 1990**

[54] **TOTALLY INTERNALLY REFLECTING THIN, FLEXIBLE FILM**

[75] Inventor: **Sanford Cobb, Jr., St. Mary's Point, Minn.**

[73] Assignee: **Minnesota Mining and Manufacturing Company, St. Paul, Minn.**

[21] Appl. No.: **218,087**

[22] Filed: **Jul. 12, 1988**

Related U.S. Application Data

[63] Continuation of Ser. No. 903,655, Sep. 5, 1986, abandoned, which is a continuation-in-part of Ser. No. 799,869, Nov. 21, 1985, abandoned, and a continuation-in-part of Ser. No. 819,118, Jan. 15, 1986, abandoned.

[51] **Int. Cl.**[4] **G02B 5/04**; G02B 5/124; G02B 5/136

[52] **U.S. Cl.** **350/286**; 350/103; 350/109

[58] **Field of Search** ..... 350/286, 287, 276 R, 350/616, 617, 167, 168, 103, 104, 106, 109; 362/32, 339, 337

[56] **References Cited**

U.S. PATENT DOCUMENTS

2,175,067	10/1939	Rolph	240/106
2,218,227	10/1940	Winnek	13/61
2,232,551	2/1941	Merton	18/57
2,248,638	7/1941	Merton	156/10
2,279,555	4/1942	Browne et al.	88/24
2,723,919	11/1955	Pohnan	117/35
3,288,990	11/1966	Stahlhut	240/106
3,689,346	9/1972	Rowland	156/245
3,908,056	9/1975	Anderson	428/142
4,118,763	10/1978	Osteen	362/339
4,120,565	10/1978	Rabl et al.	350/286
4,154,219	5/1979	Gupta et al.	126/270
4,235,515	11/1980	Sheiman et al.	350/138
4,244,683	1/1981	Rowland	425/143
4,260,220	4/1981	Whitehead	350/96.28
4,389,085	6/1983	Mori	350/96.10
4,422,719	12/1983	Orcutt	350/96.30
4,466,697	8/1984	Daniel	350/96.30
4,497,860	2/1985	Brady, Jr.	428/156
4,576,850	3/1986	Martens	428/156
4,615,579	10/1986	Whitehead	350/96.1
4,805,984	2/1989	Cobb	350/96.28

FOREIGN PATENT DOCUMENTS

2127344	4/1964	United Kingdom	.

Primary Examiner—Bruce Y. Arnold
Assistant Examiner—Ronald M. Kachmarik
Attorney, Agent, or Firm—Donald M. Sell; Walter N. Kirn; Stephen W. Buckingham

[57] **ABSTRACT**

A thin, flexible film made of a transparent polymeric material including a structured surface and an opposite smooth surface, wherein light striking either surface, within certain angular ranges, is totally internally reflected. The structured surface includes a linear array of miniature substantially right angled isosceles prisms arranged side-by-side to form a plurality of peaks and grooves. In addition, the perpendicular sides of the prisms make an angle of approximately 45° with the smooth surface, and when the film is curled the smooth surface lies in a smooth continuous arcuate curve without materially affecting the performance of the film. Because of the film's flexibility and its ability to totally internally reflect light, it may be utilized in a variety of ways, for example, as a collector of solar energy or as a light conduit. The performance of the film may be manipulated to permit controlled light leakage.

13 Claims, 4 Drawing Sheets